

WATER MOVEMENTS IN THE NANTICOKE REGION OF LAKE ERIE 1974

February 1976



Ontario

Ministry
of the
Environment

The Honourable
George A. Kerr, Q.C.,
Minister

Everett Biggs,
Deputy Minister

Copyright Provisions and Restrictions on Copying:

This Ontario Ministry of the Environment work is protected by Crown copyright (unless otherwise indicated), which is held by the Queen's Printer for Ontario. It may be reproduced for non-commercial purposes if credit is given and Crown copyright is acknowledged.

It may not be reproduced, in all or in part, for any commercial purpose except under a licence from the Queen's Printer for Ontario.

For information on reproducing Government of Ontario works, please contact ServiceOntario Publications at copyright@ontario.ca

WATER MOVEMENTS IN THE
NANTICOKE REGION OF
LAKE ERIE

1974

Balbir Kohli
Lake Systems
Water Modelling Section
Water Resources Branch
Ontario Ministry of the
Environment
135 St. Clair Avenue West
Toronto, Ontario

February 1976

ALUX

WATER MOVEMENT IN THE NANTICOKE REGION OF LAKE ERIE 1974

INTRODUCTION

As recommended by the Nanticoke Environmental Committee (NEC), the water movement study, in the coastal region of Lake Erie, southeast of Nanticoke Generating Station, continued during 1974. The results of the present study are compared with previous studies to determine any changes in water movement patterns.

Current instruments operated from April 19 to November 27, 1974 at two locations (027 and 028-see Fig. 1) in the coastal regions of Lake Erie, offshore of Nanticoke. The data were statistically analysed to determine spatial and temporal characteristics of water movements. Time series analysis of the data identifies the periodicities resulting from physical mechanisms responsible in the area.

METHOD

Submersible electronically recording current instruments were operated at two nearshore locations (see Fig. 1) in Lake Erie, southeast of Nanticoke as follows:

Location Code	Instrument Depth from bottom	Total Water Depth	Period 1974
027	3.0 m	6.1 m	8 Aug-27 Nov
028	3.0 m	6.7 m	20 Apr-24 Oct

Plessey current instruments (Model M021) were used in the present study. The instruments recorded current directions and temperature at a preset interval, (10 or 20 minutes-See Table 1 for details) and current magnitudes (speed integrated over the preset interval).

DATA ANALYSIS

All data were pre-whitened after Blackman and Tuckey (1959, pages 29, 39, 174) using binomial smoothing coefficients after Panofsky and Brier (1968, page 150). For easy comparison with the results of the previous studies, the data at both locations were divided into monthly records.

For each record, two dimensional frequencies of occurrence of current magnitude and direction were then computed and tabulated (see Appendix 1). A summary of results appears in Table 1. The resultant currents varied from 0.9 to 5.8 cm/sec with persistence factors of 0.29 to 0.89. The arithmetic average speed varied from 2.5 to 7.0 cm/sec while the maximum speed ranged from 12.6 to 37.8 cm/sec. The net currents (see Figure 1) appear to travel offshore except at location 027 during October and November.

One dimensional frequency of occurrence of temperature with monthly means and standard deviations were computed and are presented in Table 2. It may be observed from Table 2 that the monthly temperature variations were between 5 and 10 °C during the study period of July to November 1974.

Spectral analysis identifies physical processes responsible for the generation of currents, by relating observed and theoretical periodicities. Autospectra of hourly mean components (of pre-whitened data) along north-south and east-west directions were computed by standard numerical techniques and the Hanning of the coefficients (See Table 3) after Blackman and Tuckey (1959, pages 34 and 171).

Figures 2, 3 and 4 present the monthly fluctuations of water levels at Port Dover, mean current speeds offshore of Nanticoke and mean wind speeds at Simcoe respectively for comparison.

DISCUSSION

A summary of current results is presented in Table 1. The measured speeds were less than 0.3 cm/sec for 2 to 30 percent of the recorded period. These statistics indicate good water movement in the area.

The coastal region at Nanticoke is considered homogeneous and dynamically connected (NEC, 1973). Therefore, the water movement results of 1974 locations may be compared with those of the 1973 and the pre-operational period of 1968-70 although the studies were conducted at different locations during each year. Table 4 presents some important comparative water movement statistics for all locations and periods examined so far in the coastal region of Nanticoke. It may be observed from Table 4 that for a large percentage of time, the currents travelled towards the resultant direction. Table 4 also shows that most of the time the currents were either travelling towards or opposite to the resultant direction (i.e. along the line of the resultant direction-"resultant axis"). In 17 out of a possible 32 times, currents travelled along the "resultant axis" for 50% or more of the total time. Only 3 out of 32 times, currents moved along the resultant axis for less than 30% of the total time. Thus, the resultant axis was the most predominant direction of water movement during all periods of study. However, during 1973, the water movements were along the resultant axis for only 14 to 39% of the time-which is the lowest recorded in any one year. Distances travelled along the resultant direction in 10 h (arbitrarily chosen period) were computed (see Table 4) as a measure of comparison. These distances are NOT actually travelled but may be used for qualitative comparison of water movements at different

locations and periods. The means and standard deviations of these distances for each year and for the pre-operational period (1968-70) are also presented in Table 4. The results of the pre-operational period and 1974 are similar but results for 1973 indicate low water movements. As water levels during 1973 and 1974 were similar (see Fig. 2), the slower currents during 1973 cannot be attributed to the higher water levels compared to previous years. Wind speed does not appear to explain the low currents either as no differences were detected from year to year (see Fig. 4). The low currents of 1973 cannot be explained by this simple analysis of either the winds or the water levels.

The net transport directions in 1968, 1969 and 1973 were parallel to the shore or offshore, but in 1974 the resultant currents were onshore at station 027 during October and November. For the rest of the period during 1974 the net currents moved either parallel to the shore or offshore.

The major spectral periods (in hours) in north-south and east-west directions are presented in Table 3 for both locations. Semi-diurnal periodocities (12 h) were observed in north-south direction during August 1974 and in the east-west direction during November 1974. Semi-diurnal periodocities are commonly associated with the lunar tides. The 12 h periodocities in north-south direction during August 1974 may also be associated with the onshore-offshore summer winds. Hamblin (1974) found semi-diurnal tides of different amplitudes all over Lake Ontario. No periodic motions were observed in the east-west direction at 027 during August 1974, and the north-south direction at 027 during September 1974, nor in the north-south direction at 028 during April and May 1974. Periods of 3 h and less are generally related to the local shoreline geometry or could be higher order harmonics of the lakewide seiches. 15 h periods observed at location 028 during June 1974 in east-west and north-south directions reflect lakewide effects. (15 h periodocities were also observed in Lake Ontario (Kohli and Palmer, 1973)).

Table 5 presents the significant spectral periods at different locations and months for the present and previous studies for easy comparison. In 1968-69, lakewide and diurnal periodocities of 16, 20, 22 and 24 h were prevalent and periodocities of less than 4.5 h did not exist in the records. In 1973 the highest significant periodocity was 10.9 h and four periodocities of less than 3 h existed. In 1974 the highest periodocity was 15 h and eight periodocities of less than 3 h existed. The larger periodocities are not prominent in the records of 1973 and 1974. Such smaller periodocities indicate that the nearshore movement phenomena were more influenced by local geometry in 1973 and 1974.

The monthly average water temperatures varied from 10.9 to 21.3°C between July and November 1974. The monthly standard deviations ranged from 0.9 to 2.5°C while monthly temperatures spread (between the lowest and highest temperatures recorded during a month) was 5 to 10°C. These results compare favourably with the measurements during the similar months of pre-operational study (See Table 6) when the monthly mean temperatures varied between 7.4 and 21.1°C while the monthly standard deviations ranged from 0.5 to 3.5°C.

CONCLUSIONS

The water movements of 1974 were similar to those of the pre-operational study. However, the 1973 results showed slower movements. The net transport directions during the pre-operational period and 1973 were either parallel to the shore or offshore. The 1974 study found similar net transport directions except for October and November when the resulting currents were onshore at one station. The monthly temperatures spread varied from 5 to 10°C with a standard deviation of 0.9 to 2.5°C. No significant differences in water temperatures were observed between the present and the pre-operational study.

The magnitude of the significant periodocities have decreased in 1973 and 1974 indicating the emerging predominance of nearshore effects over lakewide effects.

REFERENCES

- Blackman, R.B. and J.W. Tuckey, 1959: The Measurement of Power Spectra. Dover Publications, Inc. New York, 198p.
- Hamblin, P.F. 1974. Short period tides in Lake Ontario (IFYGL). Proc. 17th Conf. Great Lakes Res. 1974, pp. 789-800.
- Kohli, B.S. 1974. Water Movements in the Nanticoke Region of Lake Erie 1973. Ontario Ministry of the Environment, 1 St. Clair Avenue West, Toronto, Ontario 18p.
- Kohli, B.S. and M.D. Palmer, 1973. Assessment of a waste outfall location 1970-2. Proc. 16th Conf. Great Lakes Res. 1973. pp. 754-773.
- NEC (Nanticoke Environmental Committee), 1973. The Aquatic Ecosystem of Long Point Bay in the Vicinity of Nanticoke, Vol. 3, Water Movements. 108p.
- Panofsky, H.A. and G.W. Brier, 1968: Some Applications of Statistics to Meteorology. The Pennsylvania State University, University Park, Pennsylvania.

TABLE 1: Summary of Current Meter Results, Nanticoke Region, Lake Erie

	L O C A T I O N									
	027					028				
	P E R I O D									
	Aug 74	Sep 74	Oct 74A*	Oct 74B*	Nov 74	Apr 74	May 74	Jun 74	Jul 74	Oct 74
Resultant speed (cm/sec)	0.92	0.67	3.03	1.64	1.33	3.23	1.75	2.00	3.39	5.81
Resultant direction coming from 0° as North	35	295	245	255	255	306	300	305	287	301
Period of negligible velocity (<0.30 cm/sec)-% of recording period	18	15	6	10	10	15	4	30	3	2
Average speed (cm/sec)	2.53	2.29	3.85	2.91	2.69	3.62	4.66	3.51	8.37	7.01
Maximum speed (cm/sec)	14.54	12.60	33.56	15.89	31.35	14.55	18.06	25.86	37.76	22.99
Persistence	0.36	0.29	0.79	0.56	0.49	0.89	0.38	0.57	0.40	0.83
Total No. of Readings	3456	4320	604	2870	3834	720	2232	1917	1392	1872
Interval of readings (minutes)	10.0	10.0	10.0	10.0	10.0	20.0	20.0	20.0	10.0	10.0
Percentage of time going in resultant direction	27	17	47	27	29	50	39	42		49

* Oct 74A is 1-5 October 1974
 Oct 74B is 11-31 October 1974

TABLE 2

TEMPERATURE FREQUENCY, NANTICOKE REGION, LAKE ERIE
(PERCENTAGE OF OCCURRENCE)

TEMPERATURE RANGE	L O C A T I O N						
	027					028	
	P E R I O D						
	AUG 74	SEP 74	OCT 74A	OCT 74B	NOV 74	JUL 74	OCT 74
0.00 - 5.99							
6.00 - 6.99					2.99		
7.00 - 7.99					6.30		
8.00 - 8.99					15.75		
9.00 - 9.99					15.59		6.80
10.00 - 10.99					3.78		1.62
11.00 - 11.99			38.38	7.38	18.74		19.42
12.00 - 12.99		0.98	32.32	40.51	11.97		65.70
13.00 - 13.99		6.88	27.27	12.66	24.88		6.47
14.00 - 14.99		18.12	2.02	14.35		0.43	
15.00 - 15.99		15.17		25.11		4.33	
16.00 - 16.99		14.33				6.06	
17.00 - 17.99	0.35	0.84				8.66	
18.00 - 18.99	2.62	3.09				22.08	
19.00 - 19.99	3.49	24.44				38.96	
20.00 - 20.99	20.42	12.22				19.05	
21.00 - 21.99	54.10	3.93				0.00	
22.00 - 22.99	16.93					0.00	
23.00 - 100.00	2.09					0.43	
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00
MONTHLY MEAN	21.32	17.23	12.52	13.59	10.91	18.89	12.14
MONTHLY STD DEV	0.90	2.47	0.82	1.88	2.11	1.34	0.87

T A B L E 3

SUMMARY OF MAJOR SPECTRAL PERIODS (HOURS)

AUTO SPECTRA OF CURRENTS

NANTICOKE REGION, LAKE ERIE

80% CONFIDENCE LEVEL

LOCATION	PERIOD	NORTH-SOUTH	EAST-WEST
027	AUG 74	12.0, 3.5	NONE
027	SEP 74	NONE	9.2, 4.8, 3.9, 3.1, 2.4
027	OCT 74B	5.2, 3.5	3.2
027	NOV 74	10.9, 8.6, 4.8	12.0, 8.6, 4.0
028	APR 74	NONE	6.3, 2.9
028	MAY 74	NONE	2.4
028	JUN 74	15.0, 4.0, 2.9, 2.5	15.0, 2.6
028	JUL 74	2.9	4.3
028	OCT 74	6.3	5.0, 4.1, 2.7

TABLE 4

COMPARISON OF WATER MOVEMENT RESULTS WITH PREVIOUS STUDIES, NANTICOKE REGION, LAKE ERIE

Location Code	Period	Resultant Direction Coming from 0° as North	Percentage of Time Going			Percentage of Negligible (<0.3 cm/sec) Currents	Max. Percentage Occurrence in any Speed Class Range (except negligible)	Mean of Speed Class Range with Max. Occurrence (cm/sec)	Mean Speed Towards Resultant (cm/sec)	Distance Travelled Along Resultant (in 10 h) (km)	Mean of Distance Travelled (in 10 h) (km)		Standard Deviation of Distance Travelled (km)
			Towards Resultant	Opposite to Resultant	Along the Resultant Axis								
022	Aug 68	262	40	14	54	15	27	4.5	6.2	2.2	2.62	1.29	1.18
022	Sep 68	277	45	23	68	10	33	4.5	5.1	1.8			
023	Sep 68	277	52	11	63	54	25	1.7	2.7	1.0			
021	Oct 68	272	44	26	70	18	25	4.5	7.2	2.6			
022	Oct 68	271	59	17	76	10	20	4.5	9.8	3.5			
023	Oct 68	268	52	11	63	31	22	1.7	6.2	2.2			
021	Nov 68	298	36	26	62	28	27	4.5	3.7	1.3			
022	Nov 68	273	85	0	85	1	23	4.5	13.2	4.7			
023	Nov 68	273	59	22	81	21	20	4.5	12.0	4.3	1.95	0.96	1.18
021	May 69	256	43	13	56	36	21	1.7	6.2	2.2			
024	May 69	278	50	16	66	31	16	7.5	9.0	3.2			
021	Jun 69	74	33	28	61	38	25	1.7	3.1	1.1			
022	Jun 69	255	24	9	33	24	25	4.5	5.0	1.8			
024	Jun 69	276	38	9	47	28	21	4.5	9.6	3.5			
021	Jul 69	67	22	15	37	29	29	1.7	3.5	1.3			
022	Jul 69	15	54	1	55	25	22	4.5	4.6	1.7			
024	Jul 69	18	12	7	19	35	22	1.7	2.2	0.8	1.45	1.48	1.18
021	Jan 70	255	40	25	65	41	20	4.5	6.8	2.5			
021	Feb 70	69	33	12	45	74	10	4.5	1.1	0.4	0.79	0.42	1.18
025	Jul 73	16	16	7	23	19	23	1.7	3.5	1.3			
026	Jul 73	125	10	4	14	57	15	1.2	1.6	0.6			
026	Aug 73	77	28	11	39	74	15	1.2	0.7	0.3			
026	Sep 73	107	25	12	37	48	15	3.0	2.7	1.0	2.23	1.35	1.18
028	Apr 74	306	50	1	51	15	16	1.5	5.8	2.1			
028	May 74	300	30	9	39	4	15	4.0	6.8	2.4			
028	Jun 74	305	42	8	50	30	20	1.7	4.6	1.7			
028	Jul 74	287	18	13	31	3	17	3.0	15.4	5.5			
027	Aug 74	35	27	15	42	18	19	1.5	4.1	1.5			
027	Sep 74	295	17	5	22	15	21	1.5	2.2	0.8			
027	Oct 74A	245	35	5	40	6	31	1.5	5.0	1.8			
027	Oct 74B	255	26	7	33	10	22	1.5	4.4	1.6			
028	Oct 74	301	49	2	51	2	21	3.0	9.7	3.5			
028	Nov 74	255	26	10	36	10	36	1.7	3.8	1.4			

TABLE 5: COMPARISON OF SPECTRAL RESULTS WITH PREVIOUS STUDIES*, NANTICOKE REGION, LAKE ERIE
SPECTRAL PERIODS (HOURS)

MONTH	AXIS	LOCATION CODE								
		022	023	021	022	024	025	026	027	028
		YEAR OF OPERATION								
		1968	1968	1969	1969	1969	1973	1973	1974	1974
APR	N-S									NONE
	E-W									6.3,2.9
MAY	N-S			20.0		NONE				NONE
	E-W			20.0,13.7		20.0,10.0				2.4
JUN	N-S				NONE	NONE				15.0,4.0
	E-W				17.1,12.0	17.1				2.9,2.5
JUL	N-S			NONE		17.1				15.0,2.6
	E-W			10.9		NONE	6.3,3.2	3.8,3.2,2.4		2.9
AUG	N-W	20.0,14.0,9.0					10.9,2.9	8.6,5.7,2.7		4.3
	E-W	15.0,11.0,6.0						NONE	12.0,3.5	
SEP	N-S	NONE	NONE					4.1,2.3	NONE	
	E-W	22.0,13.0,7.8	24.0,11.0,7.4,4.5					NONE	NONE	
OCT	N-S	NONE	NONE						9.2,4.8,3.9	
	E-W	NONE	11.0						3.1,2.4	
NOV	N-S	16.0	NONE						5.2,3.5	6.3
	E-W	20.0,12.0,7.2,6.0	24.0,11.0,5.5,4.5						3.2	5.0,4.1
									10.9,8.6	2.7
									4.8	
									12.0,8.6,4.0	

* NEC, 1973

* Kohli, B.S. 1974, Water Movements in the Nanticoke Region of Lake Erie 1973,
Ontario Ministry of the Environment, 1 St. Clair Avenue West, Toronto, Ontario

TABLE 6: Comparison of Water Temperatures with Previous Studies, Nanticoke Region, Lake Erie

Location Code	Period	Mean ($^{\circ}\text{C}$)	Std. Dev. ($^{\circ}\text{C}$)
021	Aug 68	20.97	0.93
022	Aug 68	21.08	0.92
022	Sep 68	20.72	0.80
023	Sep 68	17.86	0.70
021	Oct 68	14.83	2.29
022	Oct 68	12.17	3.48
023	Oct 68	12.49	2.18
021	Nov 68	10.17	0.50
022	Nov 68	7.38	0.74
023	Nov 68	8.14	1.50
021	May 69	9.71	1.13
024	May 69	7.76	1.20
021	Jun 69	11.60	1.49
022	Jun 69	12.89	1.79
024	Jun 69	10.86	1.46
021	Jul 69	16.61	2.12
022	Jul 69	17.21	2.78
024	Jul 69	14.34	2.22
021	Jan 70	0.57	0.27
021	Feb 70	0.50	0.00
028	Jul 74	18.89	1.34
027	Aug 74	21.32	0.90
027	Sep 74	17.23	2.47
027	Oct 74A	12.52	0.82
027	Oct 74B	13.59	1.88
028	Oct 74	12.14	0.87
027	Nov 74	10.91	2.11

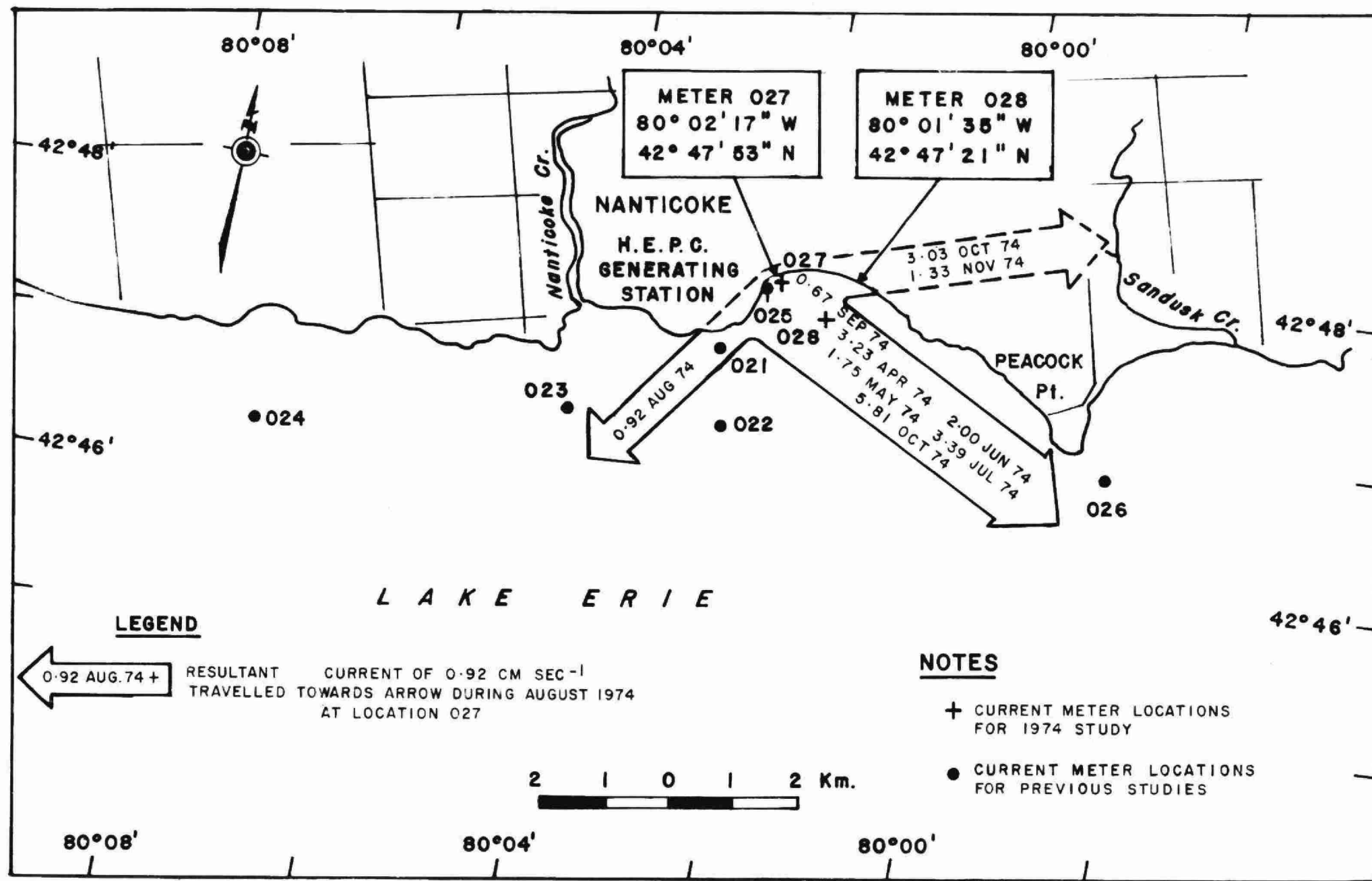


FIGURE 1: RESULTANT CURRENTS AT 1974 LOCATIONS NANTICOKE REGION, LAKE ERIE

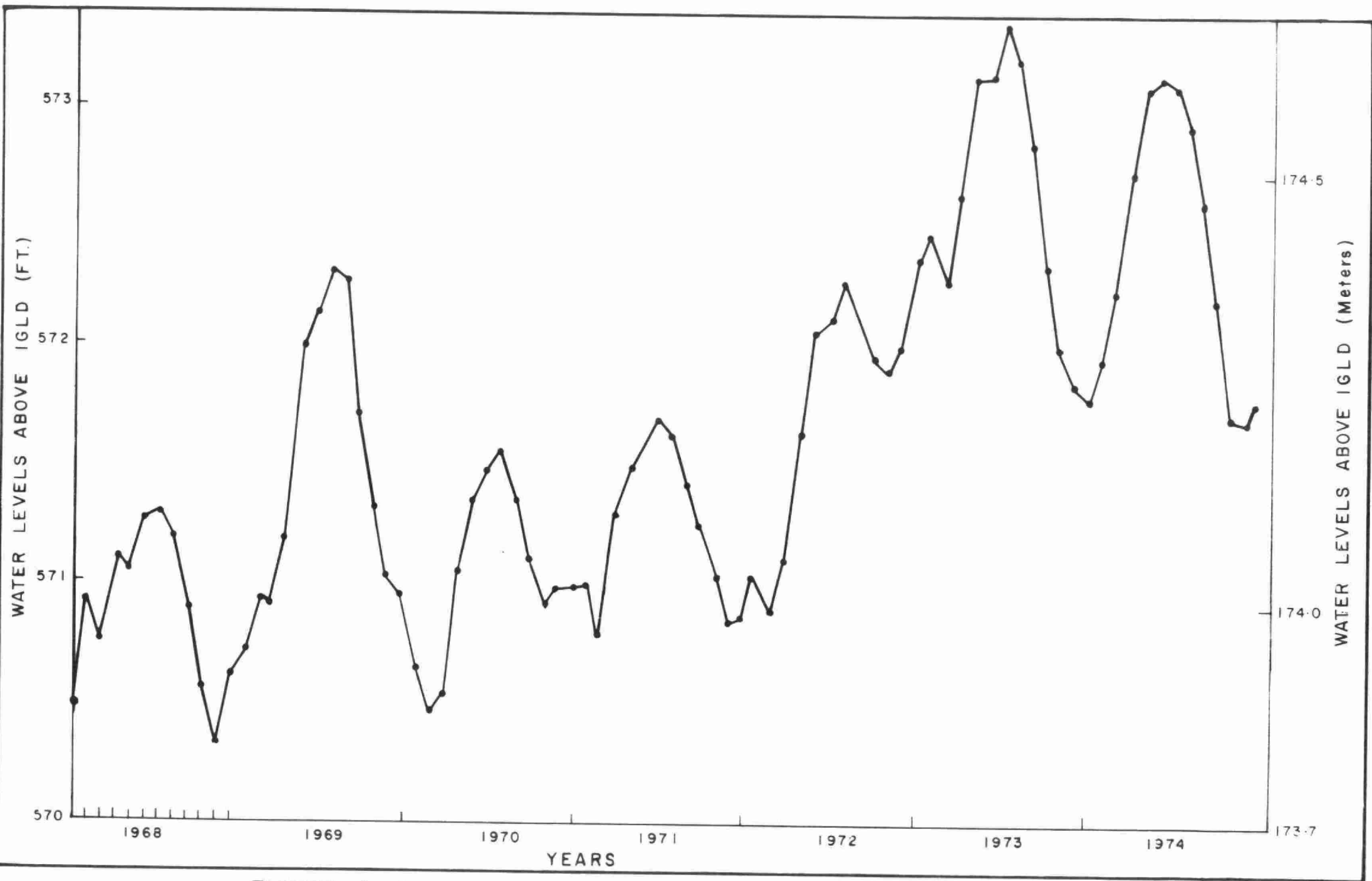


FIGURE 2: WATER LEVELS AT PORT DOVER — LAKE ERIE

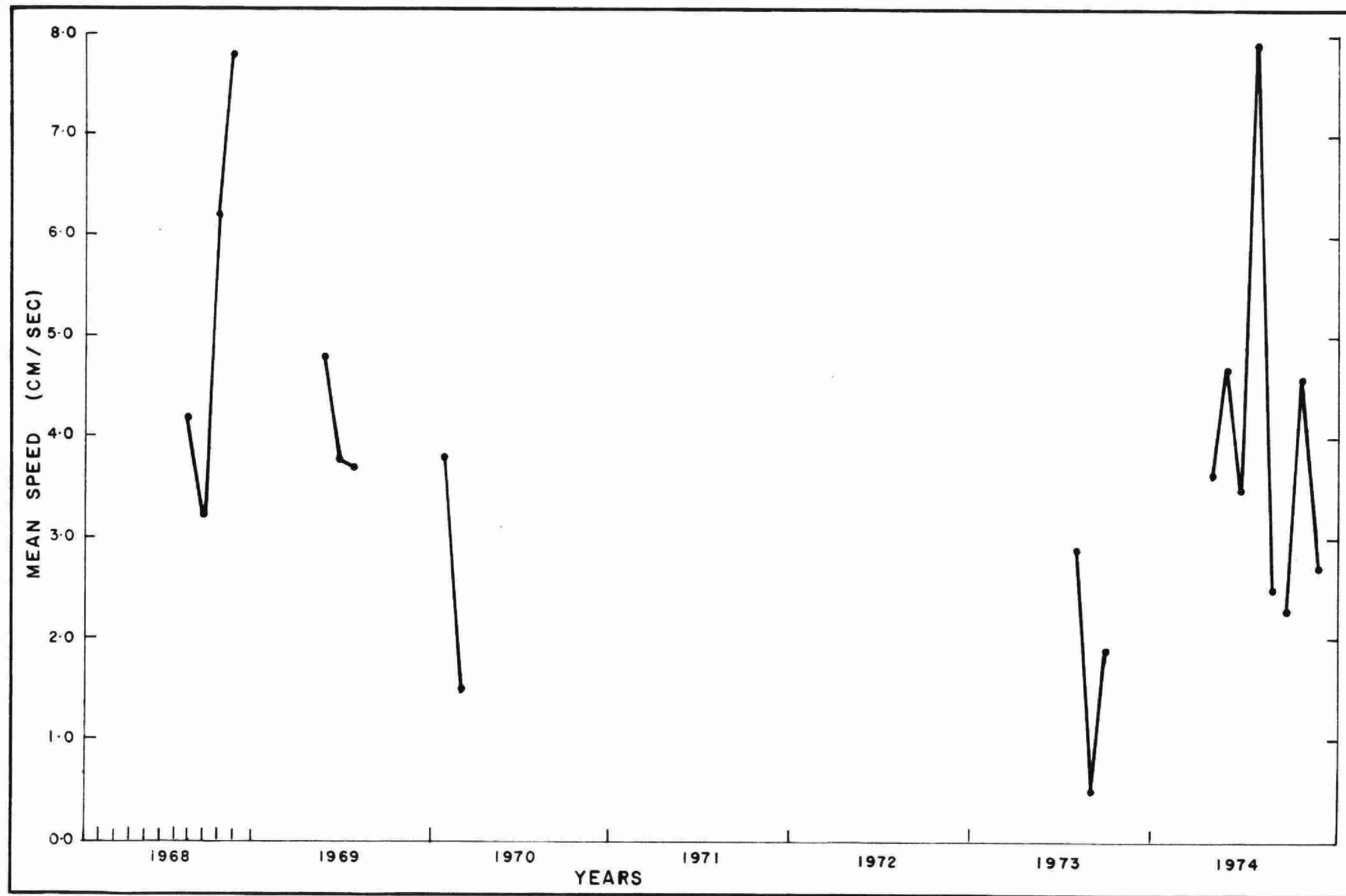


FIGURE 3 : MEAN MONTHLY CURRENT SPEED VARIATIONS
NANTICOKE REGION, LAKE ERIE

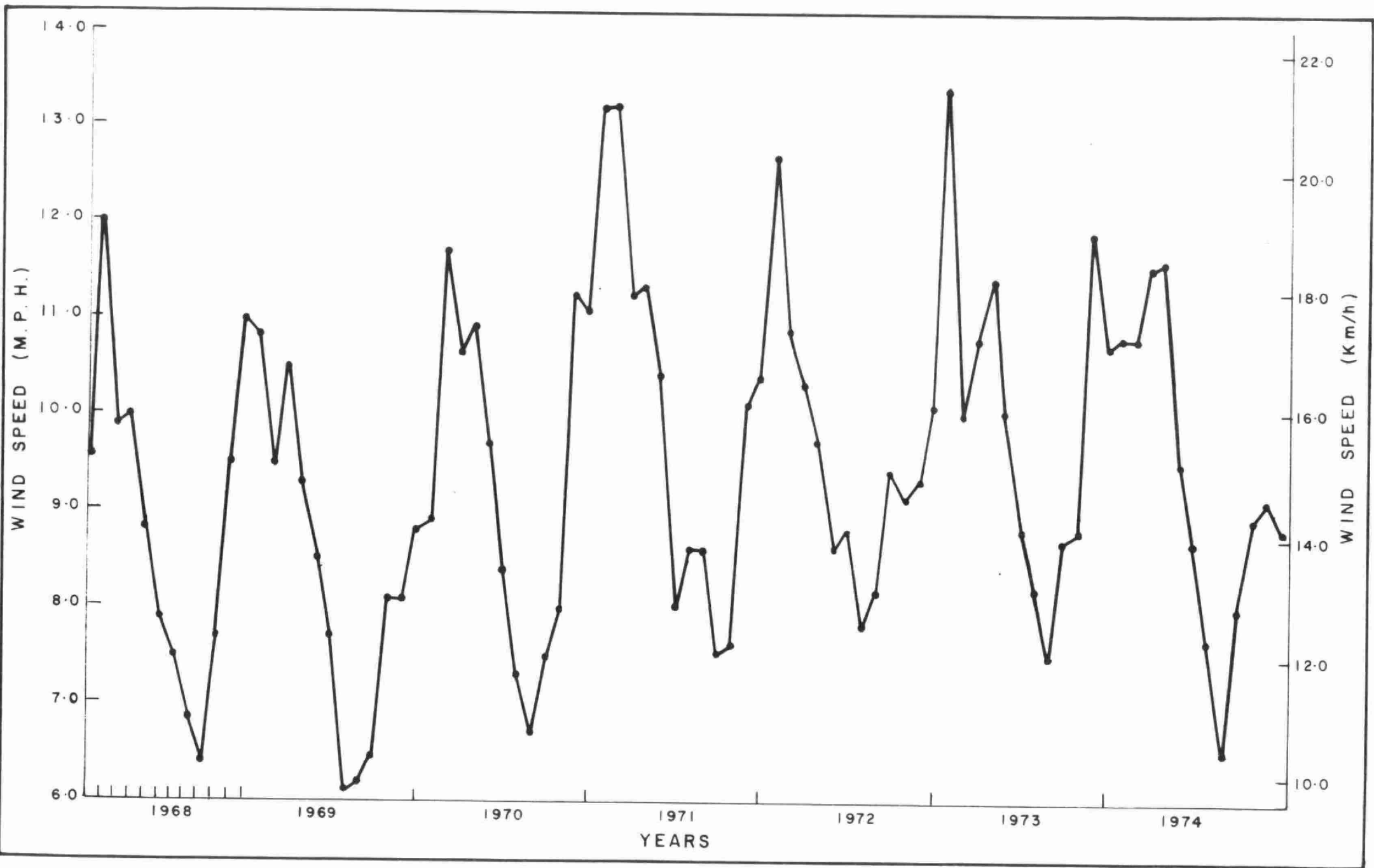


FIGURE 4 : WIND SPEED AT SIMCOE, ONTARIO

APPENDIX I

Frequency tables (1.01 to 1.10) for currents at locations 027 and 028, Nanticoke Region, Lake Erie, 1974.



Ministry of the
Environment

Ontario

TABLE 1.01

LOCATION CODE: 027 (Nanticoke Region, Lake Erie)

PERIOD: AUGUST 1974

LATITUDE : 42° 47' 53" N

LONGITUDE : 80° 02' 17" W

FREQUENCY TABLE

SPEED (CM/SEC.)	DIRECTION COMING FROM (DEGREES)								
	337.50 - 22.49	22.50 - 67.49	67.50 - 112.49	112.50 - 157.49	157.50 - 202.49	202.50 - 247.49	247.50 - 292.49	292.50 - 337.49	ROW SUMS
0.0 - 0.30	2.37	2.36	3.73	1.59	1.59	1.91	2.40	1.91	13.37
0.31 - 0.99	1.45	2.52	3.27	2.14	1.62	2.52	2.11	1.07	16.70
1.00 - 1.99	2.31	4.69	2.72	1.35	1.27	3.53	2.03	0.84	19.30
2.00 - 2.99	1.65	4.30	0.90	0.93	0.92	2.46	1.71	0.49	13.37
3.00 - 3.99	1.27	4.00	0.49	0.75	0.73	1.22	0.37	0.12	9.53
4.00 - 4.99	1.33	1.94	0.34	0.64	0.43	1.48	0.61	0.09	7.35
5.00 - 14.99	3.65	6.71	1.42	0.33	0.20	1.63	1.19	0.12	15.34
COLUMN SUMS	14.03	27.00	13.37	3.33	6.39	14.79	10.97	4.63	100.00

RESULTANT CURRENT IS 0.92 CM/SEC. AT 35 DEGREES

TOTAL NO. READINGS 3456

MEAN CURRENT IS 2.53 CM/SEC.

PERSISTENCE IS 0.36

MAXIMUM CURRENT IS 14.54 CM/SEC.

READINGS TAKEN EVERY 10.0 MINUTES

INSTRUMENT WAS OPERATED 3.0 M FROM BOTTOM IN 6.1 M OF WATER



TABLE 1.02

LOCATION CODE: 027 (Nanticoke Region, Lake Erie)

PERIOD: September 1974

LATITUDE : 42° 47' 53" N

LONGITUDE : 80° 02' 17" W

FREQUENCY TABLE

SPEED (CM/SEC.)	DIRECTION COMING FROM (DEGREES)								ROW SUMS
	337.50 - 22.49	22.50 - 67.49	67.50 - 112.49	112.50 - 157.49	157.50 - 202.49	202.50 - 247.49	247.50 - 292.49	292.50 - 337.49	
0.0 - 0.30	1.91	1.55	1.34	0.93	1.20	1.74	2.57	3.40	14.54
0.31 - 0.99	2.25	1.94	1.00	1.04	1.04	2.04	3.33	3.06	15.69
1.00 - 1.99	3.06	2.96	1.39	1.16	2.66	2.75	4.12	3.54	21.64
2.00 - 2.99	3.75	2.92	0.79	0.60	1.90	2.80	3.38	2.01	18.24
3.00 - 3.99	1.76	1.60	0.42	0.30	1.20	2.37	3.33	1.27	12.75
4.00 - 4.99	1.46	1.39	0.16	0.09	0.60	1.73	1.31	0.76	9.06
5.00 - 12.99	2.20	1.74	0.19	0.02	0.65	2.06	1.69	0.44	9.07
COLUMN SUMS	16.37	14.10	5.22	4.14	9.26	16.13	20.23	14.49	100.00

RESULTANT CURRENT IS 0.67 CM/SEC. AT 295 DEGREES

TOTAL NO. READINGS 4320

MEAN CURRENT IS 2.29 CM/SEC.

PERSISTENCE IS 0.29

MAXIMUM CURRENT IS 12.60 CM/SEC.

READINGS TAKEN EVERY 10.0 MINUTES

INSTRUMENT WAS OPERATED 3.0 M FROM BOTTOM IN 6.1 M OF WATER



Ministry of the
Environment

Ontario

TABLE 1.03

LOCATION CODE: 027 (Nanticoke Region, Lake Erie)

LATITUDE : 42° 47' 53" N

LONGITUDE : 80° 02' 17" W

PERIOD: 1-5 October 1974

FREQUENCY TABLE

SPEED (CM/SEC.)	DIRECTION COMING FROM (DEGREES)								ROW SUMS
	337.50 - 22.49	22.50 - 67.49	67.50 - 112.49	112.50 - 157.49	157.50 - 202.49	202.50 - 247.49	247.50 - 292.49	292.50 - 337.49	
0.0 - 0.30	0.33	0.83	0.33	0.33	1.16	0.66	0.50	0.17	5.79
0.31 - 1.99	1.49	5.13	1.66	3.64	2.15	4.64	10.10	2.65	31.46
2.00 - 3.99	0.17	0.66	0.0	0.0	2.65	7.45	13.41	1.32	25.65
4.00 - 5.99	0.0	0.0	0.0	0.0	0.66	5.96	5.30	1.49	13.41
6.00 - 7.99	0.0	0.0	0.17	0.0	0.17	5.63	6.29	0.0	12.25
8.00 - 9.99	0.0	0.0	0.0	0.17	0.17	4.97	3.15	0.0	8.44
10.00 - 33.99	0.0	0.0	0.0	0.50	0.33	1.32	0.66	0.17	2.98
COLUMN SUMS	2.48	6.62	2.65	5.13	7.23	30.63	39.40	5.79	100.00

RESULTANT CURRENT IS 3.03 CM/SEC. AT 245 DEGREES

TOTAL NO. READINGS 604

MEAN CURRENT IS 3.85 CM/SEC.

PERSISTENCE IS 0.79

MAXIMUM CURRENT IS 33.56 CM/SEC.

READINGS TAKEN EVERY 10.0 MINUTES

INSTRUMENT WAS OPERATED 3.0 M FROM BOTTOM IN 6.1 M OF WATER



Ontario

Ministry of the
Environment

TABLE 1.04

LOCATION CODE: 027 (Nanticoke Region, Lake Erie)

PERIOD: 11-31 October 1974

LATITUDE : 42° 47' 53" N

LONGITUDE : 80° 02' 17" W

FREQUENCY TABLE

SPEED (CM/SEC.)	DIRECTION COMING FROM (DEGREES)								ROW SUMS
	337.50 - 22.49	22.50 - 67.49	67.50 - 112.49	112.50 - 157.49	157.50 - 202.49	202.50 - 247.49	247.50 - 292.49	292.50 - 337.49	
0.0 - 0.30	1.67	1.01	0.66	0.38	0.17	0.38	2.33	3.07	9.69
0.31 - 0.99	3.03	1.29	0.52	0.52	0.31	3.21	2.20	3.24	14.32
1.00 - 1.99	3.97	4.13	0.59	1.11	1.05	6.52	2.44	2.44	22.30
2.00 - 2.99	2.20	2.09	0.07	0.17	1.22	7.04	2.44	2.51	17.74
3.00 - 3.99	2.09	0.84	0.0	0.07	0.59	5.16	1.71	1.29	11.74
4.00 - 4.99	0.59	1.32	0.0	0.0	0.24	2.96	1.78	0.70	7.60
5.00 - 15.99	0.30	1.15	0.0	0.0	0.14	10.03	3.76	0.73	16.62
COLUMN SUMS	14.36	11.88	1.85	2.26	3.73	35.30	16.66	13.97	100.00

RESULTANT CURRENT IS 1.64 CM/SEC. AT 255 DEGREESTOTAL NO. READINGS 2870MEAN CURRENT IS 2.91 CM/SEC.PERSISTENCE IS 0.56MAXIMUM CURRENT IS 15.89 CM/SEC.READINGS TAKEN EVERY 10.0 MINUTESINSTRUMENT WAS OPERATED 3.0 M FROM BOTTOM IN 6.1 M OF WATER



Ministry of the
Environment

Ontario

TABLE 1.05

LOCATION CODE: 027 (Nanticoke Region, Lake Erie)

PERIOD: November 1974

LATITUDE : 42° 47' 53"N

LONGITUDE : 80° 02' 17"W

FREQUENCY TABLE

SPEED (CM/SEC.)	DIRECTION COMING FROM (DEGREES)								ROW SUMS
	337.50 - 22.49	22.50 - 67.49	67.50 - 112.49	112.50 - 157.49	157.50 - 202.49	202.50 - 247.49	247.50 - 292.49	292.50 - 337.49	
0.0 - 0.30	2.06	1.46	1.10	0.23	0.70	1.30	0.70	2.22	9.73
0.31 - 1.99	5.53	6.89	1.77	1.20	1.38	10.04	3.03	6.13	36.07
2.00 - 3.99	2.34	6.62	0.39	0.73	1.54	14.06	3.86	3.03	33.62
4.00 - 5.99	0.94	1.15	0.08	0.10	0.52	5.66	2.87	0.63	11.95
6.00 - 7.99	0.55	0.23	0.0	0.03	0.02	4.09	1.07	0.05	6.10
8.00 - 9.99	0.03	0.03	0.0	0.0	0.0	0.65	0.29	0.0	1.04
10.00 - 31.99	0.0	0.0	0.0	0.0	0.03	1.30	0.10	0.0	1.43
COLUMN SUMS	12.00	16.43	3.83	2.35	4.25	37.12	11.97	12.05	100.00

RESULTANT CURRENT IS 1.33 CM/SEC. AT 255 DEGREES

TOTAL NO. READINGS 3834

MEAN CURRENT IS 2.69 CM/SEC.

PERSISTENCE IS 0.49

MAXIMUM CURRENT IS 31.35 CM/SEC.

READINGS TAKEN EVERY 10.0 MINUTES

INSTRUMENT WAS OPERATED 3.0 M FROM BOTTOM IN 6.1 M OF WATER



TABLE 1.06

LOCATION CODE: 023 (Nanticoke Region, Lake Erie)

PERIOD: April 1974

LATITUDE : 42° 47' 21" N

LONGITUDE : 80° 01' 35" W

FREQUENCY TABLE

SPEED (CM/SEC.)	DIRECTION COMING FROM (DEGREES)								ROW SUMS
	337.50 - 22.49	22.50 - 67.49	67.50 - 112.49	112.50 - 157.49	157.50 - 202.49	202.50 - 247.49	247.50 - 292.49	292.50 - 337.49	
0.0 - 0.30	1.53	2.50	0.56	0.42	0.83	2.36	4.31	2.50	15.00
0.31 - 0.99	2.22	2.36	0.33	0.23	0.42	0.69	2.92	2.22	11.94
1.00 - 1.99	3.61	3.19	1.94	0.0	0.0	0.69	2.64	3.47	15.56
2.00 - 2.99	3.39	1.53	0.42	0.28	0.0	0.14	0.83	6.39	13.47
3.00 - 3.99	0.42	0.42	0.0	0.0	0.0	0.0	1.11	8.75	10.69
4.00 - 4.99	0.0	0.0	0.0	0.0	0.0	0.0	0.97	5.83	6.81
5.00 - 14.99	0.0	0.0	0.0	0.0	0.0	0.0	5.97	20.58	26.53
COLUMN SUMS	11.67	10.00	3.75	0.97	1.25	3.89	18.75	49.72	100.00

RESULTANT CURRENT IS 3.23 CM/SEC. AT 306 DEGREES

TOTAL NO. READINGS 720

MEAN CURRENT IS 3.62 CM/SEC.

PERSISTENCE IS 0.89

MAXIMUM CURRENT IS 14.55 CM/SEC.

READINGS TAKEN EVERY 20.0 MINUTES

INSTRUMENT WAS OPERATED 3.0 M FROM BOTTOM IN 6.7 M OF WATER



Ministry of the
Environment

Ontario

TABLE 1.07

LOCATION CODE: 028 (Nanticoke Region, Lake Erie)
LATITUDE : 42° 47' 21" N
LONGITUDE : 80° 01' 35" W

PERIOD: May 1974

FREQUENCY TABLE

SPEED (CM/SEC.)	DIRECTION COMING FROM (DEGREES)								ROW SUMS
	337.50 - 22.49	22.50 - 67.49	67.50 - 112.49	112.50 - 157.49	157.50 - 202.49	202.50 - 247.49	247.50 - 292.49	292.50 - 337.49	
0.0 - 0.30	0.27	0.76	0.76	0.36	0.22	0.09	0.58	1.30	4.35
0.31 - 0.99	0.63	1.08	0.58	0.54	0.58	1.08	1.61	1.16	7.26
1.00 - 1.99	0.99	1.39	1.08	1.57	0.67	1.43	3.67	3.36	14.16
2.00 - 2.99	1.61	1.57	2.02	1.57	0.63	1.75	1.93	3.76	14.63
3.00 - 3.99	0.49	1.70	3.49	1.21	0.27	1.08	2.78	3.76	14.78
4.00 - 4.99	0.49	0.76	1.30	0.72	0.04	0.63	2.24	3.94	10.13
5.00 - 18.99	0.0	0.45	7.30	3.32	0.0	0.45	10.62	12.37	34.50
COLUMN SUMS	4.48	7.71	16.53	9.27	2.42	6.50	23.43	29.66	100.00

RESULTANT CURRENT IS 1.75 CM/SEC. AT 300 DEGREES

TOTAL NO. READINGS 2232

MEAN CURRENT IS 4.66 CM/SEC.

PERSISTENCE IS 0.38

MAXIMUM CURRENT IS 18.06 CM/SEC.

READINGS TAKEN EVERY 20.0 MINUTES

INSTRUMENT WAS OPERATED 3.0 M FROM BOTTOM IN 6.7 M OF WATER



TABLE 1.03

LOCATION CODE: 023 (Nanticoke Region, Lake Erie)

PERIOD: June 1974

LATITUDE : 42° 47' 21" N

LONGITUDE : 80° 01' 35" W

FREQUENCY TABLE

SPEED (CM/SEC.)	DIRECTION COMING FROM (DEGREES)								ROW SUMS
	337.50 - 22.49	22.50 - 67.49	67.50 - 112.49	112.50 - 157.49	157.50 - 202.49	202.50 - 247.49	247.50 - 292.49	292.50 - 337.49	
0.0 - 0.30	0.63	0.73	1.62	3.34	1.04	2.45	0.89	13.88	29.63
0.31 - 1.00	2.50	2.97	2.40	1.46	2.03	4.12	1.30	3.13	19.93
2.00 - 3.00	1.62	1.51	3.60	1.20	1.20	2.30	2.92	2.92	17.27
4.00 - 5.00	1.20	0.26	2.40	1.36	0.05	0.05	1.93	4.49	11.79
6.00 - 7.00	0.37	0.05	1.20	0.89	0.0	0.0	1.20	4.85	8.56
8.00 - 9.00	0.16	0.0	0.63	0.10	0.0	0.0	0.33	3.34	5.06
10.00 - 25.99	0.05	0.0	0.0	0.0	0.0	0.0	2.87	4.35	7.77
COLUMN SUMS	6.52	5.53	11.34	3.35	4.33	3.92	12.00	42.46	100.00

RESULTANT CURRENT IS 2.00 CM/SEC. AT 305 DEGREES

TOTAL NO. READINGS 1917

MEAN CURRENT IS 3.51 CM/SEC.

PERSISTENCE IS 0.57

MAXIMUM CURRENT IS 25.36 CM/SEC.

READINGS TAKEN EVERY 20.0 MINUTES

INSTRUMENT WAS OPERATED 3.0 M FROM BOTTOM IN 6.7 M OF WATER



Ministry of the
Environment

Ontario

TABLE 1.00

LOCATION CODE: 028 (Nanticoke Region, Lake Erie)

PERIOD: July 1974

LATITUDE : 42° 47' 21" N

LONGITUDE : 80° 01' 35" W

FREQUENCY TABLE

SPEED (CM/SEC.)	DIRECTION COMING FROM (DEGREES)								ROW SUMS
	337.50 - 22.49	22.50 - 67.49	67.50 - 112.49	112.50 - 157.49	157.50 - 202.49	202.50 - 247.49	247.50 - 292.49	292.50 - 337.49	
0.0 - 0.30	0.65	0.72	0.14	0.0	0.29	0.50	0.93	0.07	3.30
0.31 - 1.99	0.93	1.58	1.44	1.37	2.30	2.44	1.03	0.57	12.72
2.00 - 3.99	1.65	0.93	1.30	3.09	2.44	2.30	2.37	2.08	16.67
4.00 - 5.99	0.93	1.94	2.08	2.73	1.37	1.29	1.51	1.44	13.79
6.00 - 7.99	1.29	0.79	4.17	1.65	1.94	1.94	1.65	1.72	15.16
8.00 - 9.99	0.65	0.43	3.02	0.57	0.86	2.30	1.44	1.08	10.34
10.00 - 37.99	2.37	0.22	2.44	1.29	0.29	2.08	10.56	8.76	28.02
COLUMN SUMS	3.48	6.61	15.09	11.21	10.49	12.96	19.54	15.73	100.00

RESULTANT CURRENT IS 3.39 CM/SEC. AT 237 DEGREES

TOTAL NO. READINGS 1392

MEAN CURRENT IS 8.37 CM/SEC.

PERSISTENCE IS 0.40

MAXIMUM CURRENT IS 37.76 CM/SEC.

READINGS TAKEN EVERY 10.0 MINUTES

INSTRUMENT WAS OPERATED 3.0 M FROM BOTTOM IN 6.7 M OF WATER



TABLE 1.10

LOCATION CODE: 028 (Nanticoke Region, Lake Erie)

PERIOD: October 1974

LATITUDE : 42° 47' 21" N

LONGITUDE : 80° 01' 35" W

FREQUENCY TABLE

SPEED (CM/SEC.)	DIRECTION COMING FROM (DEGREES)								ROW SUMS
	337.50 - 22.49	22.50 - 67.49	67.50 - 112.49	112.50 - 157.49	157.50 - 202.49	202.50 - 247.49	247.50 - 292.49	292.50 - 337.49	
0.0 - 0.30	0.64	0.32	0.0	0.05	0.11	0.0	0.32	0.96	2.40
0.31 - 1.99	2.40	4.33	0.64	0.16	0.32	1.92	2.46	3.42	15.65
2.00 - 3.99	3.74	2.83	2.99	0.48	0.11	0.80	2.62	7.05	20.62
4.00 - 5.99	0.48	1.37	2.56	0.91	0.0	0.05	5.45	6.46	17.79
6.00 - 7.99	0.0	0.16	1.01	0.11	0.0	0.0	2.40	5.24	8.92
8.00 - 9.99	0.0	0.0	0.05	0.05	0.0	0.0	2.03	6.73	8.87
10.00 - 22.99	0.0	0.0	0.0	0.0	0.0	0.0	6.41	19.34	25.75
COLUMN SUMS	7.26	9.51	7.26	1.76	0.53	2.73	21.69	49.20	100.00

RESULTANT CURRENT IS 5.81 CM/SEC. AT 301 DEGREES

TOTAL NO. READINGS 1872

MEAN CURRENT IS 7.01 CM/SEC.

PERSISTENCE IS 0.83

MAXIMUM CURRENT IS 22.99 CM/SEC.

READINGS TAKEN EVERY 10.0 MINUTES

INSTRUMENT WAS OPERATED 3.0 M FROM BOTTOM IN 6.7 M OF WATER

